

Report of Working Group 3

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Five Questions:

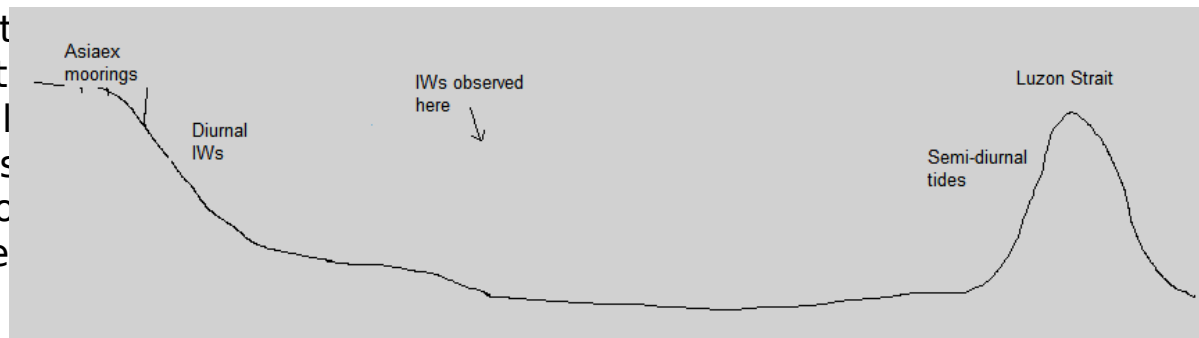
What are the scientific questions to be advanced for Non Linear Internal Waves Initiative (NLIWI):

1. Related questions in “Unknown” areas, such as generation in South China Sea?
2. To resolve modal transformations of internal waves?
3. What observational methods will yield a break-through in obtaining an answer to these questions and for producing a framework for a prediction system?
4. What type of theoretical modeling and remote sensing research will lead to a prediction system?
5. What is an appropriate framework for considering the interaction of NLIWI with acoustics?

front developed at the beginning? What is the generation mechanism? How does the observed diurnal modulation on the west side of the SCS originate? What turns the generation mechanism on or off depending on the state of the tides? Looking at some images it appears that a sharp front may be traveling across the SCS since non-linear effects would be necessary to smooth its appearance. This should be checked as should the effect of intrusion of warm water by the Kuroshio current, which occurs October through December.

If, as is likely the waves are generated in the vicinity of the Luzon Straits sills, it is desirable that some modeling efforts are put into determining the tidal response. For example, under what conditions is the flow over the sill controlled? Do large lee waves form and are these released and travel back over the sill? Can any predicted wave features be reconciled with SAR imagery? We need to use the results of this modeling and remote sensing analysis to design the field experiment. This effort could have implications for the timing of the experiment.

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New Jersey:

The generation mechanism may be like that in Primer, the steepening of the internal tide at the shelf. But this may change seasonally at New Jersey. Therefore several experimental periods are required throughout the year at New Jersey, perhaps 4 times (summer, fall, winter, and spring) for 30 days if affordable.

There appears to be no surface expression here from late fall to early spring, when the thermocline is deep. Could surface current oscillations still be detected? We need to measure meteorological forcing.

It would be highly desirable to have a model running in this area in order to design the experiment. It is useful to distinguish between the comprehensive model required to explain the detailed structure of wave generation and highly simplified models that can be used to study the wave steepening past the shelf.

2. Modal Transformations

Several mechanisms may be in operation:

- a. Splitting—a wave coming into a shoaling area can break into two waves.
- b. Change from up to down due to deepening of top layer
- c. Non linear steepening
- d. Differential steepening due to depth. Different sign at different depths
- e. Bottom boundary layer effects, both mixing and frictional
- f. Change in stratification can affect the modal transformation
- g. River runoff in general, but not in SCS or NJ
- h. Storms (wind conditions)
- i. Interaction with mesoscale features (upwelling), or islands (not NJ)
- j. Seasonal changes of stratification in SCS alters the arrival time and therefore the local barotropic modulation

3. Breakthrough Observational Methods

- a. Inverted Echo Sounder on bottom could get pressure, scale stratification depth;
some adaptations may be desirable for use in shallow water.
- b. Dye line could be laid down and tracked with airborne LIDAR
- c. Neutrally buoyant rafts floats could get vertical excursions. This would require a large number of floats that are tracked with acoustic beacons.

- a. Three-dimensional models of internal wave generation should be developed,
 - but should be preceded by parameter studies of existing two-dimensional models tested by existing remote sensing.
- b. Models explaining features seen in remote sensing such as internal wave evolution, interaction with sea floor, crossings and mergings must be developed.
- c. A hierarchy of models is necessary, from very simple to complex.
- d. Archiving and investigating historical remote sensing data is recommended.
- e. Remote sensing will not provide complete information. In situ data must supplement it.
- f. Airborne imaging is highly desirable to watch temporal development of IWs.

5. Interaction with Acoustics

- a. Along wave crest implications, for example irregularities and intersecting crests are important. We can contribute modeling and data about these variabilities.
- b. Similar considerations for acoustic propagation perpendicular to crests
- c. Intersection of distinct wave packets - check present theory.
- d. Need not only forward acoustic modeling (given oceanography, predict acoustic effects) but also inverse models (can acoustic effects tell us about oceanography?)